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August 19, 2011

**Via Email**

J. Stephen Kennedy, Esq.  
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4268 I-55 North  
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Jackson, Mississippi 39211

Subject: Quinn v. Maverick and Luke James Cayson  
Exponent Project No. 1105979.000

Dear Mr. Kennedy:

You retained Exponent Failure Analysis Associates (Exponent) to conduct a scientific, engineering, and biomechanical evaluation pertaining to the above captioned member, which involved a frontal motor vehicle collision with Mr. Christopher Quinn. This letter report serves as a summary of the technical consulting services provided to date. In general, we anticipate offering opinions related to the areas of biomechanics, occupant kinematics, injury mechanics, restraint usage, accident reconstruction, and human factors.

## **Information Reviewed**

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The following items have been received, considered, and reviewed:

- Complaint, dated August 31, 2010
- State of Mississippi Uniform Crash Report, dated January 27, 2010
  - Thirty-six (36) color copies of photographs
- Medical Records of Christopher Quinn
  - Southern Diagnostic Imaging;
  - St. Dominic Jackson Memorial Hospital;
  - Mobile Medic Ambulance Service Inc./American Medical Response;
  - Mississippi Headache Center; and
  - Mississippi Surgical Center.
- Depositions:
  - Christopher Quinn dated June 23, 2011; and
  - Erin Quinn dated June 23, 2011.
- Expert report of Mr. Lane S. VanNgen

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Along with the above-mentioned material, Exponent personnel inspected an exemplar 2000 Toyota Tacoma on August 17, 2011. During this inspection, a surrogate matching Mr. Quinn's approximate height and weight was placed in the vehicle to document the anthropometry apropos the rigid structures of the vehicle interior. One hundred and thirteen photographs were recorded and the measurements are contained within these photographs.

## **Incident Information**

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### **Complaint**

According to the complaint, the subject incident occurred on January 27, 2010. Mr. Christopher Quinn was traveling east on NW Progress Parkway in Jackson, Mississippi. He was traveling in the direction of the sun with his sunvisor down while wearing sunglasses. At some point, he collided with the rear of a tractor-trailer, which was allegedly parked partially in the roadway.

### **State of Mississippi Uniform Crash Report**

According to the State of Mississippi Uniform Crash Report, the subject incident took place on January 27, 2010 at approximately 7:18 AM on 2030 NW Progress Parkway 600 feet east of the intersection with NW Industrial Parkway. At that time and location, Mr. Christopher M. Quinn was operating a 2000 white Toyota Tacoma traveling eastbound on NW Progress Parkway. A 2006 orange Manac trailer owned by Maverick Leasing LLC was parked on the south side of NW Progress Parkway facing east. The crash location was indicated as the "Roadway". The light condition was "Daylight", the road condition was "Dry", and the weather condition was "Clear".

According to the collision narrative, the Tacoma was traveling eastbound on NW Progress Parkway when it collided with the rear of the Manac trailer (Figure 1). The Manac trailer was parked "partly on the street and partly [on the] shoulder." The Tacoma came to rest facing southeast. Reportedly, Mr. Quinn did not see the Manac trailer because of the "brightness of sun in the east."

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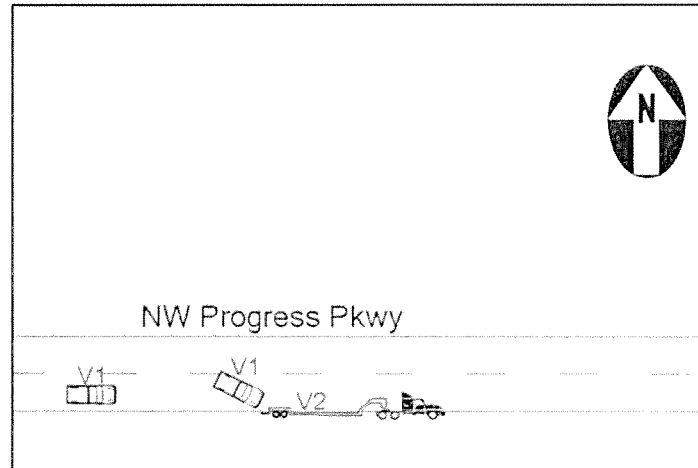


Figure 1. Diagram from the Mississippi Uniform Crash Report depicting the subject collision sequence

According to the report, Mr. Quinn was not utilizing the seatbelt, he sustained “Moderate” injuries, and the airbag did not deploy. Vehicle contact was indicated as the front-right area of the Tacoma and the rear-left area of the Manac trailer.

## Testimony and Statements

According to the deposition of Mr. Quinn, he worked for Arch Aluminum (Quinn pg. 8). He worked at Arch everyday and traveled occasionally (Quinn pg. 26). The accident took place at approximately 7:15 am on his usual route and time going to work (Quinn pg. 29-30). Mr. Quinn testified that the accident occurred on Northwest Progress Parkway as he was driving east (Quinn pg. 30). According to Mr. Quinn, the sun was in his eyes and he did not see the truck until he was 2 feet from it (Quinn pg. 30 & 31). Mr. Quinn testified that as soon as the sun comes up above “that” building it shines in the direction the road faces and “you could not look forward without being blinded” (Quinn pg. 31). During his deposition, Mr. Quinn testified that he usually did not have that much trouble with the sun (Quinn pg. 33). According to Mr. Quinn, it was similar to driving in the fog, because he could barely see in front of him. He indicated that he was just trying to keep it straight (Quinn pg. 43).

Mr. Quinn testified that he was looking down the road in front of his vehicle. He was trying not to get too far in the left lane as to avoid oncoming traffic (Quinn pg. 32). He was trying to stay where his vehicle was supposed to be on the road (Quinn pg. 32). According to Mr. Quinn, the truck he hit was parked at the top of a gradual hill (Quinn pg. 32). Mr. Quinn testified that the truck was parked in the middle of the road with more than half of the truck in the road (Quinn pg. 41). Mr. Quinn had not seen any other

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trucks parked in a similar fashion (Quinn pg. 41). According to Mr. Quinn, he has occasionally seen trucks parked all the way off the side of the road in the area where the subject truck was (Quinn pg. 41). Mr. Quinn testified that it was a practice that occurred sometimes (Quinn pg. 41). According to Mr. Quinn, the fact that he had seen trucks parked there before the accident was in his mind as he was driving down the road. He attempted to keep a clear distance from the side of the road (Quinn pg. 43). According to Mr. Quinn, there was enough room for the truck to get off the road. He testified that there was at least 3 feet between the side of the truck and the edge of the pavement (Quinn Pg. 58).

During the deposition of Mr. Quinn, he testified that he was "on that" truck before he had time to react (Quinn pg. 33). He tried to hit the brakes and turn to the left (Quinn pg. 33). Just prior to the subject collision, Mr. Quinn was traveling a little over 30 mph or about 30 mph, and was not wearing his seatbelt (Quinn pg. 34 & 47). The next thing Mr. Quinn recalled was seeing white and then realizing he hit the truck (Quinn pg. 34). According to Mr. Quinn, 2/3 of his head went through the windshield, from his lips up (Quinn pg. 34-35). He knew he was hurt because he could not see out of his eyes (Quinn pg. 35). After he collided with the truck, he tried to back up his vehicle, but it would not back up (Quinn pg. 64). He was able to back up 2 or 3 feet, but when he backed up, his tire was lodged underneath the wheel well and fell out (Quinn pg. 64). His right front tire came off as he was trying to extricate his vehicle as opposed to coming off during the impact (Quinn pg. 64). Mr. Quinn testified that he got out of his truck, looked in the mirror and he walked between his truck and the Maverick truck (Quinn pg. 64). There were no cones, flashers on, or any warning of any sort behind or in front of the truck (Quinn pg. 57).

## **Medical Records Pertaining to Christopher Quinn**

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### **Prior to the Accident**

According to Mr. Quinn's deposition testimony, Mr. Quinn began having headaches off and on starting in the fourth grade (Quinn pg. 19). Mr. Quinn stated that as he became older, the headaches began to affect his everyday life and he could no longer live with them, which prompted him to seek treatment (Quinn pg. 19). Mr. Quinn stated that he was having three to four headaches a month prior to seeking treatment (Quinn pg. 21). On July 24, 2006, Mr. Quinn presented to Mitchell Myers, M.D. at the Mississippi Headache Center. At that time, Dr. Myers noted that Mr. Quinn had migraines with visual blurring and his attacks were generally during the early morning hours. Dr. Myers started Mr. Quinn on Corgard for preventive therapy, Imitrex for his primary abortive strategy. Mr. Quinn and his wife were taught to inject Toradol for rescue should the Imitrex fail.

On September 12, 2006, Mr. Quinn returned to Dr. Myers. During this return visit, it was noted that Mr. Quinn's progress was excellent and his headaches were under control. On December 7,

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2006, Dr. Meyers noted that Mr. Quinn's progress was excellent. On June 7, 2007, Dr. Myers noted that Mr. Quinn was doing nicely and was having no major problems. On February 7, 2008, Dr. Myers noted that Mr. Quinn was doing well overall. On August 14, 2008, Dr. Myers noted Mr. Quinn was doing great with very few headaches. On September 10, 2009, Dr. Myers noted that Mr. Quinn experienced one headache per month and was having a lot of neck stiffness. On February 12, 2009, Dr. Myers noted that Mr. Quinn was experiencing one headache every two months. Mr. Quinn also testified that after he started taking his medication, he experienced one headache a month or every six weeks (Quinn pg. 21).

#### **On and After the Date of the Accident**

On the day of the subject incident, (1-27-2010) Mr. Quinn was transported to the hospital by EMS personnel via ambulance. Mr. Quinn's date of birth was listed as September, 27, 1979. According to the American Medical Response Patient Care Report, Mr. Quinn was ambulatory at the scene and located in the driver's position of his vehicle. The report indicated that Mr. Quinn was not utilizing the available seatbelt and the airbag did not deploy. He had an initial and final Glasgow Coma Scale of 15. The narrative section of the report indicated:

- "Facial trauma"
- "Migraine headaches"
- Multiple facial lacerations
- "Self-extricated"
- "head went through windshield"
- no loss of consciousness

According the Emergency Department records from St. Dominic-Jackson Memorial Hospital, Mr. Christopher Quinn was admitted and discharged on January 27, 2010. The report stated, "there are multiple lacerations with a total length of 1-2cm noted over the following areas: face and posterior scalp." There were "multiple superficial lacerations to face and head". Mr. Quinn was complaining of head and neck pain.

The ER records indicated a history of "pt was an unrestrained driver involved in a 2 car MVA in which he rear-ended an 18 wheeler... head did go through windshield." Physical exam revealed abrasion over the left maxillary area, abrasion over the middle of forehead, abrasion over the nose, horizontal laceration located over the left eyebrow that is 2 cm in length, and a horizontal laceration located over the posterior occipital scalp that is 2 cm in length.

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On January 27, 2010, a CT scan of Mr. Quinn's head was performed and interpreted by Stephen Crawford, MD. His impressions included "no acute complication of trauma identified."

On January 27, 2010, a CT scan of Mr. Quinn's face was performed and interpreted by Stephen Crawford, MD. His impression was "no facial bone fracture." He indicated "mild preseptal soft tissue swelling overlying both orbits, more extensive on the right."

On February 4, 2010, an MR scan of Mr. Quinn's brain was performed and interpreted by Jason Hesey, MD. His impressions were "no acute intracranial abnormality identified", and "stable MRI of the brain."

On February 4, 2010, an MR scan of Mr. Quinn's cervical spine was performed and interpreted by Jason Hesey MD. His impression was "unremarkable MRI of the cervical spine."

According to the medical records, Mr. Quinn was 6 feet tall and weighed 150 lb. on the day of the subject incident.

## Accident Reconstruction

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An accident reconstruction was conducted to determine the impact severity Mr. Quinn experienced when he ran his vehicle into the back of the parked Manac trailer. The post-collision photographs of the vehicles illustrate that the front passenger side of Mr. Quinn's vehicle came into contact with the rear driver side of the Manac trailer. The damage indicates that Mr. Quinn's right corner of the front bumper initially made contact with the under-ride bar of the trailer. Mr. Quinn's vehicle then continued to travel forward until his front bumper made contact with the rear tandem and the passenger side A-pillar made contact with the bottom of the trailer. This impact configuration would have caused Mr. Quinn's vehicle to rotate clockwise and come to rest near the rear of the trailer.

Given this impact scenario, traditional accident reconstruction methods are difficult to employ. By Mr. Quinn moving his vehicle after the collision further complicated this (Quinn pg. 64). The photographs of the vehicle, however, illustrate that Mr. Quinn's airbag was not deployed as a result of the impact forces. It is well established within the scientific community that the airbag may or may not deploy within changes of velocity (delta-V) between 8 and 12 mph [1, 2] when the forward rigid structures of the vehicle are involved in the collision (i.e. the bumper). In general, airbags will deploy when the delta-V is between 15 and 20 mph or greater[3]. Consequently, the maximum and conservative delta-V Mr. Quinn's vehicle experienced was 20 mph. In support of this, Mr. Quinn testified that he was traveling approximately 30 mph at the time of the collision, and that he was reacting about the same time he hit the trailer (Quinn pg. 33, 34 & 47). According to Mr. Quinn, he tried to hit the brakes and turn to the left (Quinn



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pg. 33). Therefore, it is probable that Mr. Quinn was able to slow his vehicle to approximately 20 mph prior to striking the rear of the trailer. Given that the weight of the tractor-trailer was several orders of magnitude heavier than Mr. Quinn's vehicle, the trailer can be considered an immovable barrier. As a result, the delta-V Mr. Quinn's vehicle experienced was slightly higher than his impact speed due to restitution.

The impact configuration indicates that the principal direction of force (PDOF) was directed to the front of his vehicle. In terms of a clock, with 12:00 o'clock to the front and 6:00 o'clock to the rear, the PDOF was directed at approximately 12:00 o'clock.

## **Biomechanical Analysis**

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Medical dictionaries define biomechanics as the science concerned with the actions of forces, internal and external, on the living body. Webster's dictionary defines biomechanics as the application of the principles and techniques of mechanics to the structure, functions, and capabilities of living organisms. In simplest terms, biomechanics is the field of science that investigates injury mechanisms, potential, and outcomes in relation to forces and motions applied to the human body during dynamic and static loading.

The biomechanical analysis performed for the subject incident was based on the materials provided (listed at the beginning of this report); fundamental laws of physics; principles of human dynamics; published, peer-reviewed biomechanical studies (involving volunteers, instrumented test dummies, computer models, and cadavers); classic biomechanical and engineering text books; vehicle crash-testing conducted by Exponent and others; statistical and epidemiological data; studies of human tissue mechanics and tolerance to forces; literature pertaining to frontal motor vehicle collisions, biomechanics, and occupant restraints; and my training, education, and experience. The evaluation also involved a review of the medical records provided.

## **Occupant Kinematics**

The occupant kinematics associated with motor vehicle collisions, such as the one experienced by Mr. Quinn have been established through numerous crash-test studies, and basic principles of physics. Physics dictates that as collision forces change the velocity of a vehicle, its occupants initially tend to remain at their current velocity with respect to the ground. The difference between the velocity of the vehicle and the velocity of the occupants produces movement of the occupants relative to the vehicle's interior. During the subject collision, Mr. Quinn's Toyota Tacoma experienced a rapid deceleration with a maximum delta-V of 20 mph when it contacted the rear-end of the subject Manac Trailer. As explained above, the PDOF was directed at 12:00 o'clock. As a result, Mr. Quinn would have moved forward relative to the interior of his vehicle until he made contact with some structure. According to Mr. Quinn's testimony and all the

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available evidence, he was not wearing his readily available 3-point safety harness (i.e. seatbelt). Therefore, his forward motion was not restrained from contacting the forward internal structures of the vehicle. The photographs of his vehicle illustrate that he moved forward into the steering wheel and continued moving until his head contacted the windshield. The steering wheel was bent as a consequence of his body making contact with this structure, and the windshield was compromised from his head making contact and passing through the glazing. This is in further support of the PDOF being directed at 12:00 o'clock.

It has been well established that seatbelts significantly reduce injury potential when worn properly. The seatbelt has the potential to either prevent contact between the head and vehicle structures or substantially mitigate the velocity of an occupant's head relative to interior vehicle structures. Utilizing the Crashworthiness Data System (CDS) from the National Automotive Sampling System (NASS), seatbelts have been shown to reduce the risk of head injury when compared to an unbelted occupant in accidents with a delta-V greater than 9 mph[4]. Heller et al. (2010) found that seatbelt use alone decreased the likelihood of Abbreviated Injury Score (AIS) 3+ head injury to less than 3% in frontal collisions with delta-V's below 37 mph. AIS 3+ injuries include injury to the brain, any basilar skull fracture, comminuted vault skull fractures, and vascular injuries such as laceration or occlusion (AAAM, 1990).

In the specific case of Mr. Quinn, the amount of head excursion he likely experienced can be determined by considering the delta-V his vehicle experienced. Head excursion is directly proportional to the delta-V. As explained above, the maximum and conservative delta-V Mr. Quinn's vehicle experienced was 20 mph. At this magnitude, the upper limit of the 98<sup>th</sup> percentile prediction interval for head displacement is approximately 21 inches[5]. During the surrogate inspection, it was determined that Mr. Quinn had an available occupant envelope of more than 24 inches (Figure 1). Therefore, it is more probable than not that Mr. Quinn would not have sustained any contact to his head, and therefore would not have sustained his documented injury pattern had he been wearing his readily available seatbelt.



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**Figure 1:** Photograph from the surrogate inspection illustrating the available distance from the head to the steering wheel.

As a result of the subject collision, Mr. Quinn's head contacted the Tacoma's windshield, which resulted in fracture of the laminated glass. Impacting headforms against various types of laminated glass has indicated that head speeds of between 14 and 18 mph can result in glass fracture<sup>1</sup>. Based on the accident reconstruction analysis provided above, Mr. Quinn's head likely contacted the windshield in this speed range. Fracture of the glass during head impact acts to reduce the likelihood of brain injury by extending the duration of impact. Results from these studies indicate that head impacts resulting in fractured laminated glass result in a less than 5% chance of serious (AIS 3) brain injury. These results are consistent with Mr. Quinn's medical records, which do not have any indication of traumatic brain injury.

## Human Factors Analysis

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Vehicle hazard lights are only effective if they are both noticed and understood. It is inaccurate to claim that their mere absence or presence can affect behavior. Mr. Quinn testified that the sun was shining in the direction of the road and that he "could not look forward without being blinded" (Quinn pg. 31). If Mr. Quinn was blinded in the forward direction, he would not have seen hazard lights to allow him to avoid the collision. Thus, they would not have provided him with any additional warning of a hazard.

Mr. Quinn also testified that when the sun was bad he could not see very far in front of him (Quinn pg. 33). The direct sunlight most likely led to Mr. Quinn experiencing both disability

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<sup>1</sup> Ejection Mitigation using Advanced Glazing: Status Report 2 – August 1999 – National Highway Traffic Safety Administration and Transportation Research Center, Inc.

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and discomfort glare. Glare occurs when the light source is much brighter than the rest of the visible area (i.e., the sun was brighter than the rest of the environment). Disability glare characterizes the reduced visibility of a target (in this case the Manac trailer) in the presence of glare. This reduction in visibility increases as the angle between the glare source (sun) and the target (Manac trailer) decreases [6]. Mr. Quinn testified that the accident occurred earlier than 7:15 a.m. (Quinn pg. 29) and that the sun was in his eyes (Quinn pg. 31). The low altitude of the sun<sup>2</sup> would have made the Manac trailer more difficult to see than if there was no glare. Discomfort glare, common on sunny days, characterizes a feeling of physical discomfort that can be severe enough to cause people to look away from the glare source [6,7]. If the sun glare was strong enough that “you could not look forward without being blinded” (Quinn pg. 31), it is reasonable to conclude that Mr. Quinn was experiencing discomfort glare as well, and could not, without pain, look down the road in the direction of the Manac trailer.

Research has shown that glare reduces the ability of people to detect objects during the day [8] and that even low glare sources can cause significant drops in object detection [9]. Mr. Quinn testified that he was “on that truck” before he had time to react (Quinn, pg. 33), suggesting that he was not able to detect the presence of the Manac trailer prior to the accident. Regardless of the presence of hazard lights, had Mr. Quinn been looking in the direction of the Manac trailer and able to see anything, the size of the Manac trailer alone should have been sufficient for him to detect, react, and avoid the accident. Additionally, Mr. Quinn testified that he had seen trucks parked in this area before and that he was thinking about this and trying to keep a clear distance from the side of the road (Quinn pg. 43). Even though he knew that trucks could be parked there and was trying to keep a clear distance, he was not able to avoid the accident and did not react until just before impact (Quinn pg. 33). These facts suggest that he either was not able to see anything due to glare or was not looking in the direction of the truck. In either scenario, the presence of hazard lights would not have prevented the accident, as they would not have been detected.

## Opinions

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We hold the following conclusions to a reasonable degree of engineering, biomechanical, and scientific certainty.

1. Mr. Quinn’s Toyota Tacoma experienced a maximum and conservative delta-V of 20 mph with a PDOF directed at 12:00 o’clock.
2. Had Mr. Quinn been wearing his readily available seatbelt he would not have struck his head on anything within the vehicle.

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<sup>2</sup> Mr Quinn’s testimony that the sun was in his eyes (Quinn pg. 31) is consistent with sun position data for the date, time, and location of the accident (Naval Oceanography Portal Sun and Moon Altitude/Azimuth Table for Jackson, Mississippi for 1-27-10)

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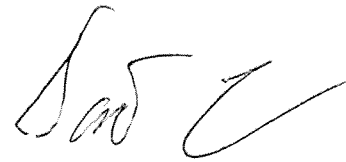
3. Had Mr. Quinn been wearing his readily available seatbelt he would not have sustained his documented head and facial injuries.
4. Mr. Quinn's head contact with the Tacoma's windshield during the subject incident resulted in less than a 5% chance of serious brain injury.
5. Mr. Quinn would not have noticed the presence of vehicular warning signal flashers . Therefore they would not have prevented the accident or changed the outcome.

This report summarizes work performed to date and presents the findings resulting from that work. The findings presented herein are made to a reasonable degree of engineering, biomechanical, and scientific certainty. We reserve the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available through ongoing discovery and/or through any additional work or review of additional work performed by others.

Sincerely,



Brian T. Weaver, P.E.  
Managing Engineer



David M. Cades, Ph.D.  
Scientist

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## Selected References

1. Dalmotas, D.J., et al., *Airbag deployments: the Canadian experience*. J Trauma, 1995. **38**(4): p. 476-81.
2. Segui-Gomez, M., *Driver air bag effectiveness by severity of the crash*. Am J Public Health, 2000. **90**(10): p. 1575-81.
3. Chan, C.-Y., *Fundamentals of crash sensing in automotive air bag systems* 2000, Warrendale, Pa.: Society of Automotive Engineers. x, 197 p.
4. Heller, M., S.M. Imler, and C.F. Corrigan, *The Effect of Frontal Collision Delta-V and Restraint Status on Injury Outcome*. SAE International: Paper # 2010-01-0145, 2010.
5. Happer, A.J., et al., *Occupant Displacement Model for Restrained Adults in Vehicle Frontal Impacts*. SAE International: Paper # 2004-01-1198, 2004.
6. Olson, P. L., & Farber, G. (2003). *Forensic aspects of driver perception and response*. Lawyers & Judges Publishing Company.
7. Perel, M., Olson, P. L., Sivak, M., & Medlin Jr, J. W. (1983). *Motor vehicle forward lighting*. Society for Automotive Engineers.
8. Schumann, J., Flannagan, M. J., Sivak, M., & Traube, E. C. (1997). Daytime veiling glare and driver visual performance: Influence of windshield rake angle and dashboard reflectance. *Journal of Safety Research*, 28(3), 133–146.
9. Theeuwes, J., Alferdinck, J. W. A. M., & Perel, M. (2002). Relation between glare and driving performance. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 44(1), 95.